

Chapter 8

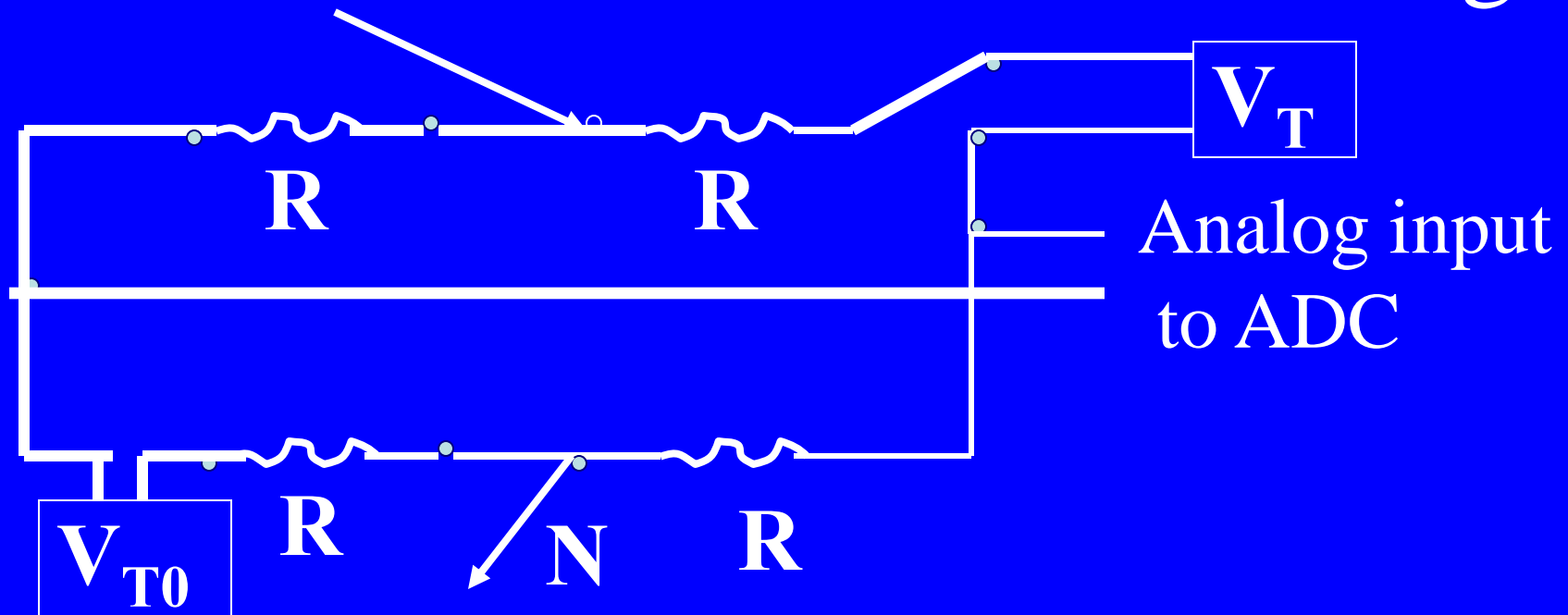
Digital and Analog Interfacing Methods

Lesson 11 Part b

Thermocouple Temperature Measuring Interfaces

Vdc or a.c. from
an oscillator

Wheatstone Bridge



Wheatstone Bridge

- Assume V_T is emf generated at hot junction of thermocouple at temperature T .
- Assume V_{T_0} is emf generated at the cold junction of thermocouple at temperature T_0

Wheatstone Bridge

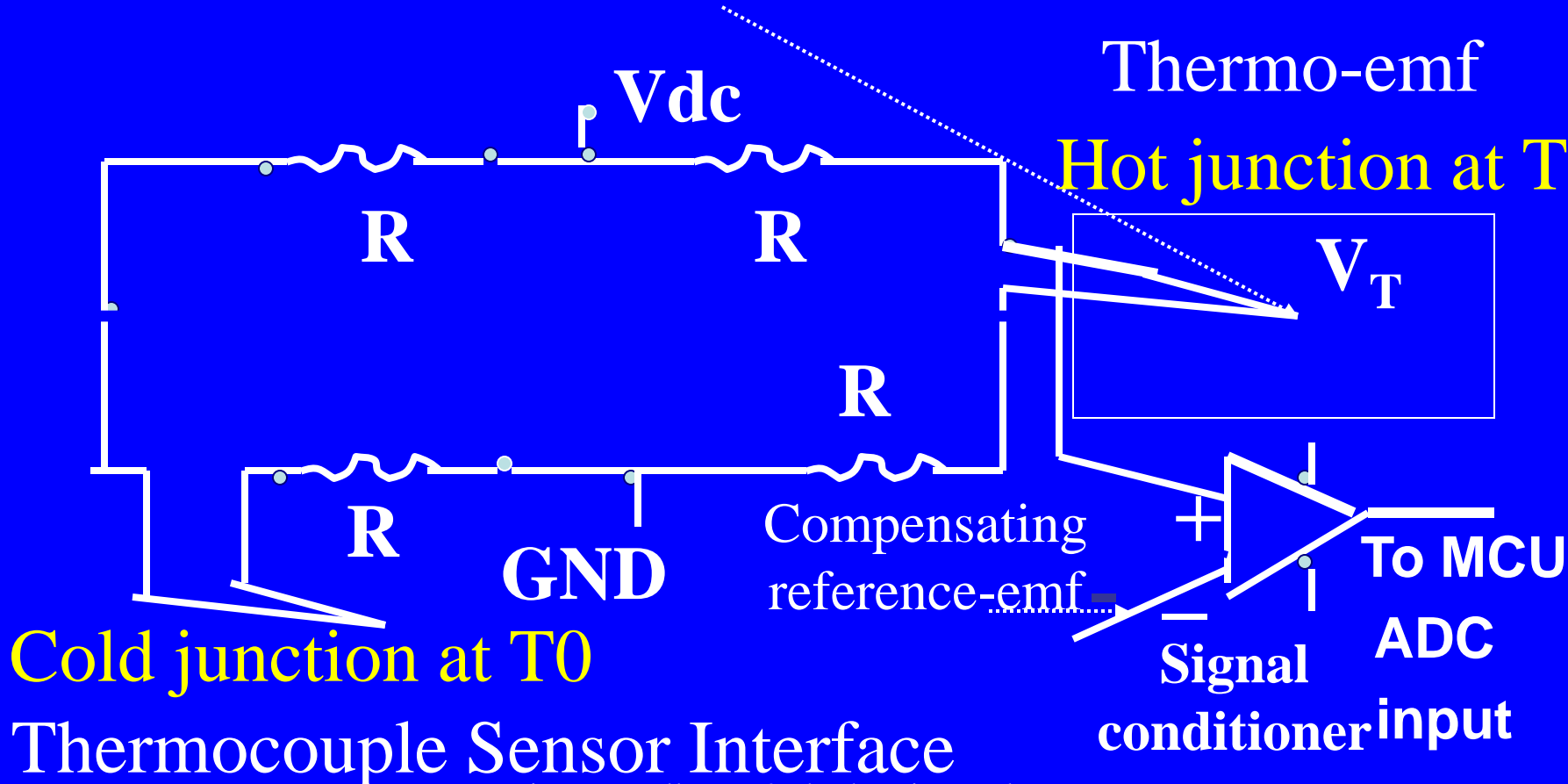
- All four arms Resistances equal and $T = T_0$ and thus $V_T = V_{T_0}$
- Thermocouple at reference temperature and the bridge is balanced
- Output = 0V for any analog input when bridge is balanced

Wheatstone Bridge

- Bridge is not balanced when T not equal to T_0
- Output not = $0V$ for a non-zero emf generated and bridge is not balanced
- All four resistances are of the same order, bridge gives maximum sensitivity

Thermo emf change on hot junction temperature T change

$$V_T = V_{T0} [1 + \alpha_{tc} (T - T0) + \beta_{tc} (T - T0)^2]$$



Cold junction at T0

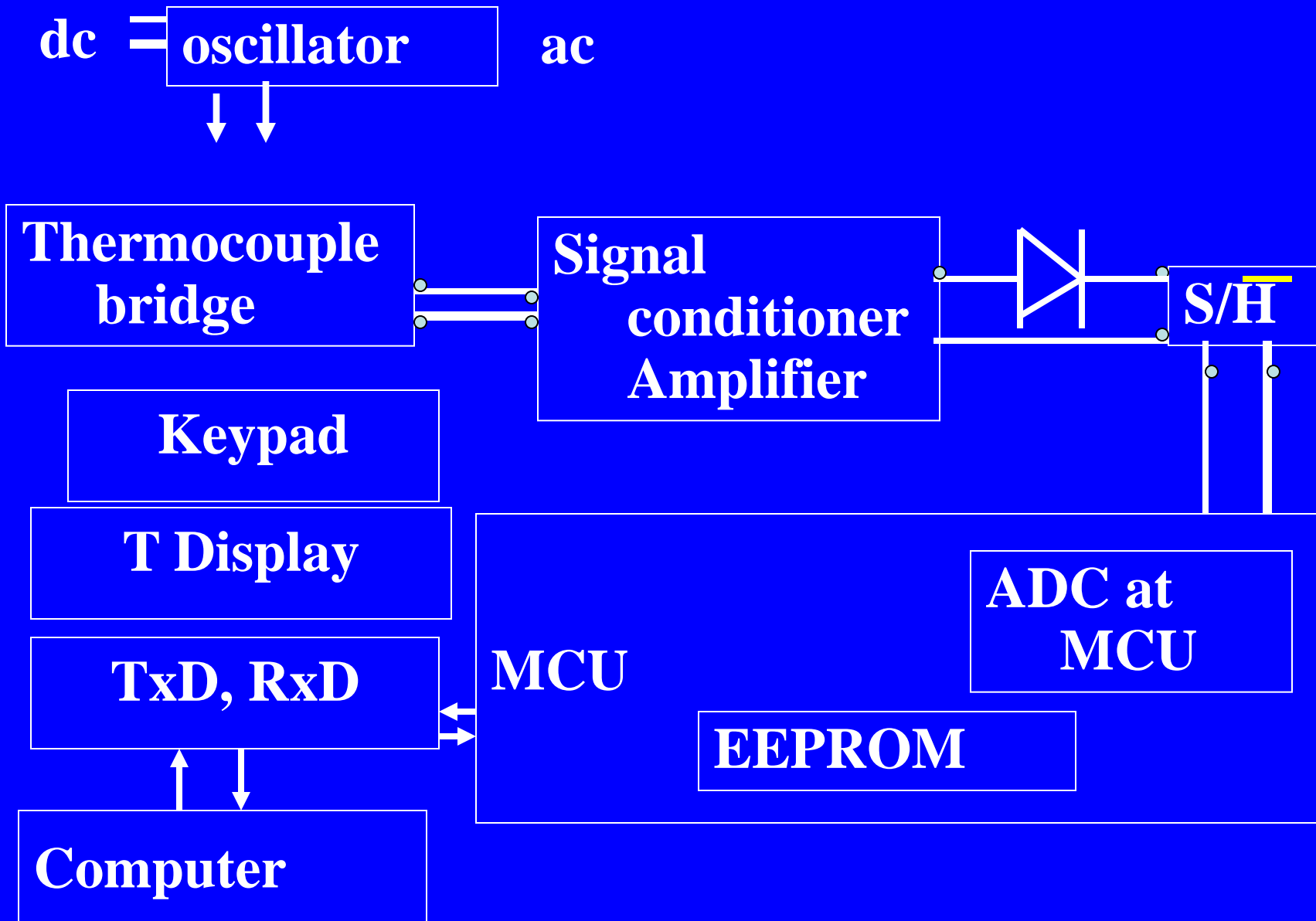
Thermocouple Sensor Interface

Signal Conditioner

- Given a compensating reference input to compensate for variation in cold junction reference temperature with respect to 0°C .
- If reference temperature not = 0°C then compensation for variation in room temperature at the cold junction required.
- Compensating reference input is generated by a thermistor or RTD circuit.

Signal Conditioner

- Compensating input and design is such that output obtained = 0 V for input to ADC when hot junction temperature is at 0°C and ADC output is then 00000000.
- For obtaining reference Voltage input V_{ref} to ADC when temperature or pressure is at certain maximum limiting value and ADC output is 11111111.



TxD and RxD Interface to Computer

- Keypad for entering the sample name, physical parameter name, time and date of measurements and other features
- Computer provides from a table calibration parameters α_{tc} and β_{tc} for the given thermocouple and saves in EEPROM

TxD and RxD Interface to Computer

- Computer records permanently the readings at different instances
- Gives graphical presentation of variation of temperature with time, shows set point for the temperature

Summary

We learnt

Analog Inputs from thermocouple hot junction

- Whetstone bridge and cold junction temperature change compensation
- Signal conditioning amplifier and S/H circuit

We learnt

Analog Inputs from thermocouple hot junction

- MCU ADC input
- Gives graphical presentation of variation of temperature with time, shows set point for the temperature

End of Lesson 1 Part b

Thermocouple Temperature Measuring Interfaces